

I-T-E® Molded Case Circuit Breakers

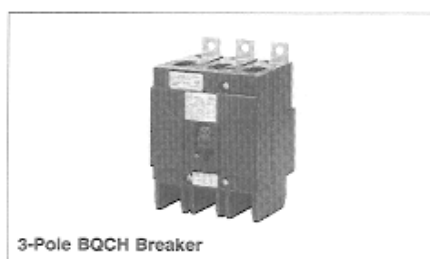
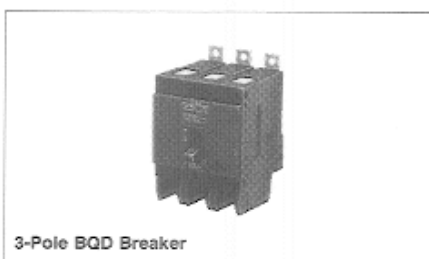
Section 2.15.1.0
Page 54
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New Page

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Proper Application of Breakers In Common 480V Systems

Application Notes & Data

The application of 480/277V AC circuit breakers such as the BQD, BQCH and 480V AC rated circuit breakers like the ED4 can be a straightforward task when properly approached. Most confusion arises when an attempt is made to use the number of phase and neutral wires, such as 3 Wire or 4 Wire, at the point of breaker application to select the proper circuit breaker. The voltage rating of the circuit breaker can only be matched with the appropriate system voltage when the system source is understood. What exactly is meant by system source? It is the utility transformer secondary, the customer transformer secondary, or possibly the customer generator that feeds the circuit breaker. No matter how many - or how few - wires are pulled from this source, the voltages remain the same throughout the system. This might seem like a rather obvious statement, but look at an example of how a misunderstanding might arise. If a job spec calls for a "480V 3 Phase 3 Wire" panelboard, what system source do you have? You might guess 480V 3 Phase 3 Wire ungrounded delta (Figure 1), and in most cases, you would be correct, but this 3 Wire panel could also be derived from several other systems, including a 480V ungrounded wye (Figure 2) or a 480/277V grounded wye (Figure 3). In the ungrounded delta and ungrounded wye there is no neutral or ground conductor, so the voltage can only be 480V AC phase-to-phase. In the grounded wye (Figure 3), the voltages will be 480V phase-to-phase and 277V phase-to-neutral and ground. *Even if*



the neutral is not carried to the panel the voltages remain the same throughout the system. The important thing to remember is that if there is a ground or neutral at the source, then the potential voltage seen in the system is the same; whether or not the physical conductor is carried throughout the distribution equipment, the common ground will provide a path for conduction. The grounded 480Y/277V system source will have the same voltages whether the panel is 1 Phase 3 Wire, 3 Phase 3 Wire, or 3 Phase 4 Wire. The 480V ungrounded delta or ungrounded wye will have the same voltage whether the panel is 1 Phase 2 Wire or 3 Phase 3 Wire. Do not look at the panel but look at the source to select the proper circuit breaker voltage rating.

Now that we have looked at the systems, let us examine the breaker ratings and how the two relate. Circuit breakers are always marked with a voltage rating as mandated by UL and the NEC. The 1993, NEC Section 240-83 (e) says that circuit breakers shall be marked with a voltage rating that is "indicative of their capability to interrupt fault currents between phases or phase to ground". The fine print note (FPN) explains this in some detail. It states that a breaker with a "straight" voltage rating, e.g., 240V or 480V, may be applied in a system in which the voltage between any two conductors does not exceed the stated voltage. These circuit breakers are tested to interrupt short circuit current at the phase-to-phase voltage. This means that these should be used on un-

grounded delta (Figure 1), or ungrounded wye systems (Figure 2), at the phase-to-phase voltage. In the next part of Section 240-83 (FPN), it further states that, a circuit breaker with a "slash" rating, e.g., 120/240V or 480Y/277V, may only be applied on a system in which the voltage to ground from any conductor does not exceed the lower marked value and the voltage between any two conductors does not exceed the higher marked value. These circuit breakers are tested to interrupt short circuit current at the lower phase-to-ground voltage and should only be applied on solidly grounded wye systems (Figure 3). Even if the neutral is not carried to the panel, the voltage to ground is the same 277V, so the slash rated breakers may be applied.

Once we understand the systems and the circuit breaker ratings, it becomes a straightforward task to apply the BQD, BQCH and the ED breakers. The BQD and BQCH are 480/277V "slash" rated and can be used on any solidly grounded 480/277V wye source system, whether or not the neutral is present at the breaker. If the application is in a panelboard and the neutral will not be carried to the panel, then, according to the UL procedures for panelboards (UL 67), you must specify that the panel be marked 480Y/277 3 phase 3 wire by the factory. The ED is "straight" rated and should be used on any ungrounded wye or ungrounded delta system. The ED could, of course, be used on the solidly grounded wye as well, but would be "over qualified" and certainly more expensive than the BQD.

